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(71) Applicant(s)
Motorola Inc

(Incorporated in USA - Delaware)

1303 East Algonquin Road, Schaumburg, Illinois 60196, United States of America

(72) Inventor(s)
Peter Joseph Armbruster
Kenneth Lee Sowles

(74) Agent and/or Address for Service
Peter D Hudson
Motorola Limited, European Intellectual Property Operation, Midpoint, Alencon Link, BASINGSTOKE, Hampshire, RG21 7PL, United Kingdom

# (54) Providing communication services to mobile user groups

(57) A system providing communications between passengers on a mobile vehicle 110 and non-passengers supports registration procedures (figs.2 and 3), for both passengers who are and are not subscribers of an accessible home network, in which registration information such as the users IMSI is sent to the home network. During an air-to-ground call attempt (fig.4), a vehicle communication control unit (VCCU), which controls a plurality of communications devices located on-board the vehicle, determines whether communication resources are available and, if so, assists in setting up a call between a passenger and a non-passenger. During a ground-to-air call attempt (fig.5), registration information for a passenger can be individually accessed at a gateway 104 in order to locate the passenger. After the gateway pages the passenger at the location, the VCCU correlates a destination identification number with a list of registered identification numbers and, if a match occurs, assists in setting up the call.

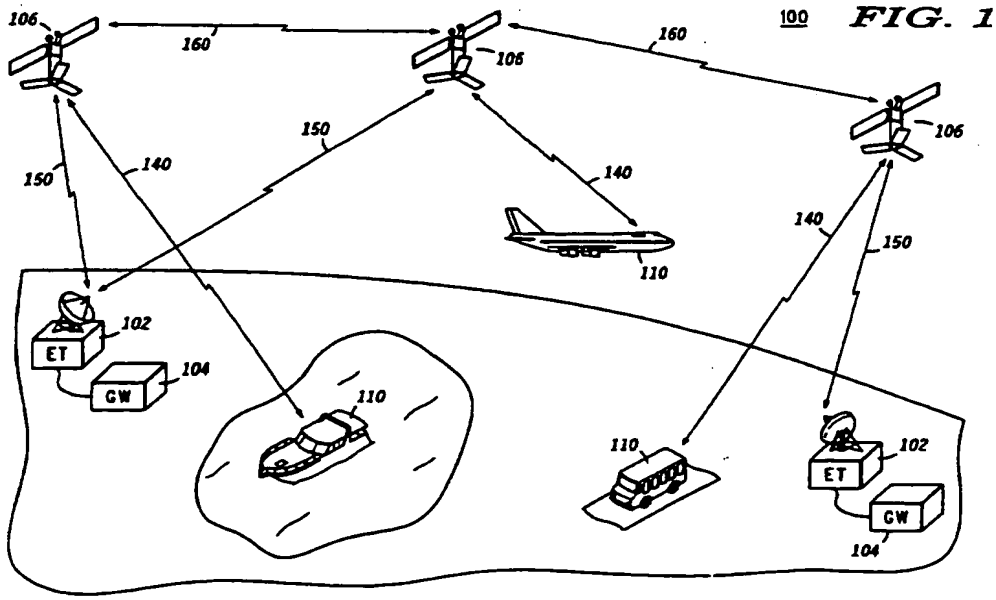


FIG. 1

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# METHOD AND APPARATUS FOR PROVIDING COMMUNICATION SERVICES TO MOBILE USER GROUPS

## Field of the Invention

This invention relates generally to radio telecommunications and, more particularly, to providing communication services to groups of communication system users who are co-located in a mobile vehicle.

## Background of the Invention

Providing telephone communication services to multiple passengers of airplanes has become common. Prior art systems use on-board equipment (i.e., equipment co-located with the airplane) which provides multiple communication channels between the airplane and a ground-based antenna which is in range of the airplane. The ground-based antenna is connected to a Public Switched Telephone Network (PSTN) which provides communication services to ground-based telephony equipment. Ground-based antennas can be linked together over terrestrial hard-wired links or through satellite links (e.g., geosynchronous satellite links).

One prior art, airplane communication system pre-assigns a "user code" or "personal identification number" (PIN) to passengers who might want to use on-board communication resources during their flight. The user code or PIN is assigned to a passenger before the passenger embarks. The passenger can disseminate the user code to any person who might want to reach the passenger during the flight. To register with the system or to place a call during the flight, the passenger enters the pre-assigned user code into the seat back handset.

The system checks a registration database to determine the airplane's location and the seat at which the passenger is located. After the system determines the airplane's location and sends a message to the airplane via an in-range ground-based antenna, the passenger's seat back handset notifies the passenger of the incoming call.

For a ground-to-air call, a person wishing to contact the passenger during the flight (referred to herein as a "ground calling party") can do so by dialing a central system number (e.g., a "1-800" number), entering the passenger's pre-assigned user code, and entering the ground calling party's phone number. The system then contacts the passenger and, if the passenger accepts the call, the system calls the ground calling

party back. The process of first calling a central number and being contacted by the system in a second, return call is referred to as "two-stage dialing".

Several aspects of this prior art system make using the system inconvenient for both passengers and others who wish to contact the passengers. As explained previously, the prior art system uses two-stage dialing, which is less convenient than if the ground calling party could directly contact the passenger using a single phone number. In addition, the prior art system does not accommodate passengers who do not have a pre-assigned user code or PIN. The requirement of the pre-assigned user code is also undesirable because the ground calling party must have knowledge of the user code in order to contact the passenger.

Another problem with the prior art is that international callers cannot access the "1-800" numbers which are used in placing a call. Therefore, international calls to passengers are not currently possible. A problem with prior art systems which use geosynchronous satellite links between antennas is that long delays can be experienced for voice traffic.

Providing communication services to other groups of co-located passengers, such as, for example, passengers of busses, ships, monorails, and other multi-passenger vehicles, also is desirable, but is not common. Groups of co-located passengers traveling in a common vehicle (e.g., an airplane, bus, ship) are referred to herein as "mobile user groups" or "co-located mobile users".

What is needed is a method and apparatus which allows direct inward dialing to a passenger during ground-to-air call attempts. Further needed is a method and apparatus which can provide communication services to a member of a mobile user-group who has not been pre-assigned a user code or PIN by the system. Further needed is a method and apparatus to minimize voice delay in communication systems which utilize satellite links. Further needed is a method and apparatus which enables international callers to be able to contact passengers.

## Brief Description of the Drawings

FIG. 1 illustrates a radio telecommunication system in accordance with a preferred embodiment of the present invention;

FIG. 2 illustrates a flowchart of a system registration method for a passenger associated with an accessible home communication network in accordance with a preferred embodiment of the present invention;

FIG. 3 illustrates a flowchart of a system registration method for a passenger not associated with an accessible home network in accordance with a preferred embodiment of the present invention;

FIG. 4 illustrates a flowchart of a method for link establishment for a passenger originated communication in accordance with a preferred embodiment of the present invention;

FIG. 5 illustrates a flowchart of a method for link establishment for a communication originating from a non-passenger in accordance with a preferred embodiment of the present invention;

FIG. 6 illustrates a block diagram of a Vehicle Communication Control Unit (VCCU) in accordance with a preferred embodiment of the present invention; and

FIG. 7 illustrates a block diagram of an Earth Terminal (ET) apparatus and a Gateway (GW) apparatus which support registration and communication for co-located mobile communication unit groups in accordance with a preferred embodiment of the present invention.

## Detailed Description of the Drawings

The method and apparatus of the present invention enables direct inward dialing to a passenger during a call attempt by a non-passenger by utilizing one-stage dialing rather than two-stage dialing. The method and apparatus of the present invention also provides communication services to a member of a mobile user-group who has not been pre-assigned a user code or PIN by the system. Further, a preferred embodiment of the method and apparatus of the present invention minimizes voice delay in communication systems which utilize satellite links by using low- or medium-earth satellite links rather than geosynchronous satellite links. Further, the method and apparatus of the present invention enables international callers to be able to contact passengers by eliminating the use of the "1-800" number stage of dialing.

FIG. 1 illustrates radio telecommunication system 100 in accordance with a preferred embodiment of the present invention. System 100 includes at least one Earth Terminal 102 (ET), which desirably includes a ground-based antenna that communicates either directly or indirectly with one or more mobile vehicles 110. Mobile vehicles 110 are generally of a type designed to transport groups of co-located persons. For example, mobile vehicles 110 could include busses, ships, monorails, and airplanes, although this list is not exhaustive.

In a preferred embodiment, system 100 includes one or more satellites 106, although satellites 106 are not necessary to practice the invention. Vehicles 110 communicate with satellites 106 over links 140 and ETs 102 communicate with satellites 106 over links 150. Satellites 106 are capable of communicating with each other over cross-links 160 and can relay messages received from vehicles 110 and ETs 102 to their desired destination (e.g., another vehicle 110 or ET 102).

In an alternate embodiment, system 100 includes satellites 106 which do not communicate directly with vehicles 110, but instead are used to relay messages between ETs 102 using cross-links 160, bent-pipe links (not shown), or a combination thereof. In still another embodiment, system 100 does not include satellites 106 and vehicles 110 communicate directly with ETs 102. The particular apparatus and types of communication links used to provide communication paths between vehicles 110 and ETs 102 can be modified from the embodiments described without departing from the scope of the present invention.

In a preferred embodiment, satellites 106 are low- or medium-earth orbit satellites rather than prior-art geosynchronous satellites. Using low- or medium-earth orbit satellites minimizes time delays which can be experienced for voice communication traffic which is sent along a communication path which uses satellites as nodes. In alternate embodiments, geosynchronous satellite links or no satellite links could be used.

For purposes of this description, when information is transferred along a communication path between a VCCU some other device (e.g., a GW or a communication unit operated by a non-passenger), the particular transmission medium and number of intermediate nodes which comprise the path are not important to the invention and can be varied depending on the system. For example, a communication path between a VCCU and a GW might include an RF link between the VCCU and a satellite, several cross-links between satellites, a down-link to an ET, and land-line links between the ET and the GW. A different communication path might include an RF link between a VCCU and an ET, and one or more bent-pipe satellite connections between the ET and the GW. Any number of different communication paths could be used.

ETs 102 are connected to Gateways 104 (GW) which provide communications capabilities with other communication networks (not shown), such as Public Switched Telephone Networks (PSTN) or ground-based cellular communication systems, for example.

In a preferred embodiment, GW 104 occasionally participates in passenger registration and supports call setup between passengers and non-passengers. GW 104 receives passenger registration information from communication equipment (not shown) co-located with mobile vehicle 110. As used herein, the communication equipment co-located with the mobile vehicle is referred to as a Vehicle Communication Control Unit ("VCCU").

The VCCU performs two major functions. First, the VCCU communicates over a communication path to a GW. Typically, the communication path includes at least one RF link. However, some systems (e.g., a system supporting monorail communications) might have no RF links. Second, the VCCU interfaces with multiple communication units which can be operated by passengers. The communication units can be, for example, telephone handsets (e.g., airplane seatback handsets), faxes, computers, or data processing units which are coupled to the VCCU using hard wired, optical, or RF links. In essence, the VCCU enables information to be gathered from passengers, sent to a GW, and vice versa.

In accordance with the present invention, passenger registration can be performed for two types of passengers: those who are already associated with a home network and those who are not associated with a home network. A preferred embodiment of the registration process for the former type of passenger is described in conjunction with FIG. 2. A preferred embodiment of the registration process for the latter type of passenger is described in conjunction with FIG. 3.

FIG. 2 illustrates a flowchart of a system registration method for a passenger associated with an accessible home communication network in accordance with a preferred embodiment of the present invention. To be "associated with an accessible home communication network" means that the home network is currently a service provider for the passenger (i.e., the passenger is a "registered subscriber" of the home network), and the home network is accessible to the system (i.e., the home network and system can exchange information between each other). In some cases, the system and the "accessible home communication network" will be one and the same.

The method begins by performing the step 200 of entering subscriber information into a communication unit. In one embodiment, the VCCU can prompt the user to enter his or her subscriber information. Subscriber information can be entered, for example, by entering digits into a keypad of a communication unit, by inserting a magnetically coded card, or when the communication unit determines the necessity to

register autonomously. Subscriber information describes the identity of the subscriber and is unique to the passenger.

In one embodiment, the subscriber information includes an International Mobile Subscriber Identity (IMSI). An IMSI is a number provided by a subscriber each time he or she accesses a communication system. The IMSI enables a system to derive the identity of the subscriber's home network. In a preferred embodiment, the subscriber information includes a Temporary Mobile Subscriber Identity (TMSI). A TMSI is an alias used instead of IMSI, when possible, to protect the identity of the subscriber.

The terms "IMSI" and "TMSI" are familiar to those of skill in the art in the context of GSM protocols. Although these terms could have connotations associated with their common usage elsewhere, these connotations are not intended to limit the scope of the present invention. What is important to the present invention is that information identifying the subscriber is sent to the home network. The particular format of the information is not important and the IMSI or TMSI are used for exemplary purposes only.

The subscriber information is sent to the VCCU and, in step 202, the VCCU sends the subscriber information over a communication path to an ET. The ET receives the subscriber information, determines the home network of the subscriber, and sends the information to the home network. Typically, a first link of the communication path is an RF link between the VCCU and the communication system. In a preferred embodiment, the first link of the communication path is an RF link between the VCCU and a satellite of the communication system. However, a vehicle which can communicate over hard-wired links (e.g., a monorail car) could send the information over a hard-wired link.

In a preferred embodiment, the subscriber information is sent with location information which can be derived by the VCCU (e.g., using geolocation). The location information describes the last-known location of the mobile vehicle. Location information is necessary for the home network to know how to route calls to the subscriber and also for billing purposes. In an alternate embodiment, the location information can be derived by the communication system, for example, using Doppler and time delay measurements.

After receiving the subscriber information, the home network then registers the subscriber in step 204. First, the home network performs an authentication procedure to determine whether the subscriber is authorized to use the system. Second, the home network associates the location information with the particular subscriber. In a

preferred embodiment, the location information is stored in one or more location registers at the home network. The location registers are typically one or more memory storage devices which contain the last known locations of communication units (or subscribers) registered with the system. The location information can be received as part of the subscriber information or in a separate message from the communication system.

Once a passenger is registered, the passenger will be allowed to use communication resources (e.g., physical equipment) of the VCCU in order to communicate with non-passengers. This enables a passenger operating a first communication unit to communicate with a non-passenger operating a second communication unit.

The method and apparatus of the present invention differs from and provides advantages over the prior art in that the method and apparatus of the present invention individually registers and tracks the location of each passenger rather than tracking the location of the mobile vehicle. In other words, the location of each passenger can be accessed based on the identity of the passenger, not the identity of the vehicle in which the passenger is traveling. This aspect of the method and apparatus of the present invention allows a passenger to be contacted without knowledge of the identity of the vehicle.

When the mobile vehicle is changing position, re-registration occasionally is necessary. The VCCU monitors, in step 206, the location of the mobile vehicle and determines, in step 208, whether re-registration of the subscriber is necessary. Re-registration becomes necessary when the location information stored in the location registers becomes obsolete (i.e., the mobile vehicle is too far from the stored location to enable the system to contact the subscriber). In a preferred embodiment, the VCCU determines that re-registration is needed when the mobile vehicle has traveled at least a pre-defined "re-registration distance" from the last registered location. In order to determine the mobile vehicle has traveled the re-registration distance, the VCCU must have previously calculated a first location of the mobile vehicle at a first time (e.g., at the last time that registration was performed). Occasionally, the VCCU computes the distance from the first location which the mobile vehicle has traveled and determines whether the distance exceeds the re-registration distance from the first location.

The re-registration distance can depend on many factors such as, for example, communication cell size and location, vehicle velocity and altitude, and system parameters. For example, a system using small communication cells to communicate

with the VCCU would have a short re-registration distance. A system using large communication cells could have a longer re-registration distance.

If re-registration is needed in step 208, the method repeats step 202 and iterates as shown in FIG. 2. If re-registration is not needed in step 208, the method repeats step 206 and iterates as shown in FIG. 2.

As explained previously, the method and apparatus of the present invention enables a passenger who is not associated with an accessible home network (or a passenger who does not wish to use his or her home network services) also to register with the communication system. FIG. 3 illustrates a flowchart of a system registration method for a passenger not associated with an accessible home network in accordance with a preferred embodiment of the present invention.

In a preferred embodiment, the method begins in step 300 when the passenger inserts a credit card (or any type of debit card) into the communication unit. In an alternate embodiment, the passenger could instead enter his or her credit card number or other debit information using the communication unit keypad. The method of entering the information is not important. What is important is that the passenger enters information which ensures that a fee can be collected for later communications between the passenger and a non-passenger.

In step 302, the VCCU then performs a preliminary credit check for the passenger in a preferred embodiment, although step 302 is not required to achieve the advantages of the present invention. The VCCU could perform the preliminary credit check, for example, by checking the expiration date of the card to make sure that the card is not expired. Alternatively, the communication system could do a preliminary or detailed credit check after the credit information is sent to the system.

In step 304, the VCCU determines whether a pre-assigned number is available for the passenger. A pre-assigned number would be a number that the communication system assigned to the passenger prior to departure. For example, when a passenger has notified a ticketing agent that the passenger might want to use communication services while traveling, a pre-assigned number could be assigned to the passenger and printed on the passenger's ticket. In a preferred embodiment, where a pre-assigned number has been previously given to the passenger, steps 300 and 302 could be optional.

Where the VCCU determines that a pre-assigned number is available, step 306 is performed, where the VCCU receives the pre-assigned number from the passenger.

The passenger can enter the pre-assigned number into the keypad after being prompted by the VCCU, for example.

In an alternate embodiment, the VCCU might already have knowledge of the pre-assigned number for the particular passenger and the handset (or seat) which the passenger would use. For example, the passenger's pre-assigned number could be entered into the VCCU memory by a ticketing agent (or other person) prior to or after departure.

The pre-assigned number is also referred to herein as a "communication number". In a preferred embodiment, the communication number is a Mobile Station ISDN number (MSISDN), which is a number that points to a record in a location register for the passenger. This record includes all information necessary for finding the final destination of a call directed to the passenger (e.g., the current location of the mobile vehicle). The term "MSISDN" is commonly used in GSM protocols. Although the term MSISDN will be used in this description, use of the term is not intended to be limited by connotations associated with its use in GSM contexts. What is important is that the communication number enables the communication system to locate a registration record for a registered passenger.

The VCCU has a pool of available communication numbers which can be used. Each pre-assigned number must be associated with a communication number of the available pool. After the pre-assigned number is entered, the VCCU validates the number in step 308. Validation entails correlating the pre-assigned number with the pool of available communication numbers (e.g., MSISDNs). Where the pre-assigned number does not correlate with one of the available communication numbers, the passenger is denied service. Where the pre-assigned number does correlate with one of the available communication numbers, the method continues at step 320.

Referring back to step 304, where the VCCU determines that no pre-assigned number is available to the passenger, the VCCU assigns, in step 312, a "communication number" (e.g., an MSISDN) to the passenger from the pool of communication numbers available to the VCCU. This is equivalent to the passenger "renting" an available communication number. The rented communication number can be assigned for the duration of the trip or for a shorter period of time. The VCCU then sends the communication number to the passenger's communication unit in step 314. The communication unit displays the communication number to the passenger in step 316. In order to receive a call, the passenger must then notify those people who might want to contact the passenger of the passenger's communication number.

Whether or not a pre-assigned number is available, the VCCU sends subscriber information describing the passenger to the communication system in step 320. Steps 320-326 are functionally equivalent to steps 202-208 described in conjunction with FIG. 2.

After a passenger has been registered with the communication system, the passenger can place calls and receive calls. Placing and receiving calls requires communication links to be established between the passengers and non-passengers.

FIG. 4 illustrates a flowchart of a method for link establishment for a passenger originated communication in accordance with a preferred embodiment of the present invention. For a passenger who is traveling on an airplane, this is typically called an "air-to-ground" call. Similarly, a communication originating from a non-passenger is typically called a "ground-to-air" call. This nomenclature will be used herein. However, because the method and apparatus of the present invention also can be used for vehicles that travel along the ground or in the water, the terms are not meant to be limiting.

The method begins when the passenger indicates that he or she wants to establish a communication path with a non-passenger. For example, the passenger may wish to make a phone call, send a facsimile, or page the non-passenger. In a preferred embodiment, the passenger indicates that he or she wants to establish a communication path by entering passenger information into the communication unit in step 400. The passenger information can be entered using the communication unit keypad or by inserting a card into the handset. The passenger information can be, for example, the user's pre-assigned number, assigned communication number, or credit card information.

The VCCU determines, in step 402, whether the passenger is a registered system user. The passenger is a registered system user if the passenger has previously performed a registration process. If the passenger is not a registered user, the VCCU registers the passenger in step 404. Registration entails performing a registration process as described in conjunction with FIGS. 2 or 3.

If the VCCU determines that the passenger is a registered system user, the VCCU determines, in step 406, whether communication resources (e.g., physical equipment) are available to allocate to the passenger's communication attempt. The VCCU is capable of supporting a finite number of communication paths between the VCCU and the communication system because physical equipment is required to sustain

each communication channel. Where the VCCU is experiencing high call demand, resources might not be available for an additional call.

Where communication resources are not available, the VCCU notifies the passenger of the call status (e.g., that a communication path cannot be established at that time because communication resources are not available) in step 408. In a preferred embodiment, in step 410, the VCCU then monitors the communication resources to determine when resources become available for the call so that the passenger can be notified. The procedure iterates as shown in FIG. 4. In an alternate embodiment, the VCCU would not monitor the communication resources or notify the passenger when resources do become available.

If the VCCU determines, in step 406, that communication resources are available, VCCU assigns available communication resources to the passenger in step 412. Then, the VCCU assists in setting up the communication path between the passenger and non-passenger in step 414.

The VCCU monitors the call, in step 416, to determine when the call is completed. When the call is not completed, the procedure iterates as shown in FIG. 4. When the call is completed, the VCCU de-allocates the communication resources previously allocated to the call in step 418 and the procedure ends.

FIG. 5 illustrates a flowchart of a method for link establishment for a communication originating from a non-passenger in accordance with a preferred embodiment of the present invention. Although the term "non-passenger" is used herein, the term is meant to refer to the fact that the non-passenger is not a passenger of the mobile vehicle on which the passenger is traveling. The non-passenger could, however, be a passenger on some other vehicle. A communication originating from a non-passenger to a passenger is typically referred to as a "ground-to-air" call as explained previously.

The method begins in step 500 when the non-passenger makes a call attempt by entering a passenger's communication number (e.g., an MSISDN) into the communication equipment used by the non-passenger. The passenger's communication number can be thought of broadly as any identification information for the passenger. The non-passenger could have knowledge of the passenger's communication number because the passenger had notified the non-passenger of the communication number prior to departure (e.g., where the passenger has a pre-assigned MSISDN), or because the passenger somehow notified the non-passenger of the communication number which was assigned to the passenger during the trip.

In a preferred embodiment, a GW receives the entered communication number and translates the entered communication number into an IMSI or TMSI in step 502. In alternate embodiments, any destination identification number can be used. An IMSI or TMSI is used herein for the purposes of description only and not of limitation.

The IMSI or TMSI enables the system to retrieve registration information for the passenger and, thus, to determine the passenger's registered location (i.e., the passenger's last-known location). The registered location could be in any form. For example, the location could be identified by a "location area code" which associates a value to a stationary or moving bounded area. Alternatively, the location could be identified by a longitude and latitude, or a range of longitudes or latitudes. The location also could be determined, for example, by extrapolating from a last-known point at which the moving vehicle was located along a vector along which the moving vehicle is traveling or expected to be traveling. The particular way that the registered location is identified is not crucial to the present invention.

Once the system determines the passenger's registered location, in step 504, the system attempts to contact the passenger's communication unit by paging the communication unit in the vicinity of the registered location. The system sends, or broadcasts, a call request to that vicinity. Assuming that the mobile vehicle is still in the vicinity of the registered location, the VCCU detects the incoming call request in step 506. From the incoming call request, the VCCU extracts the destination TMSI and, in step 508, correlates the destination TMSI with the list of TMSIs previously registered with the VCCU (referred to as "previously registered identification numbers").

The VCCU determines whether a match is found between the destination TMSI and the registered TMSIs in step 510. If no match is found (i.e., there is no correlation), the destination TMSI is not a registered passenger and the procedure ends. If a match is found (i.e., there is a correlation), the VCCU determines, in step 512, whether communication resources are available to allocate to the incoming call. In a preferred embodiment, when no communication resources are available, the VCCU informs the system of the condition and the system, in turn, notifies the non-passenger that the call cannot be completed in step 514.

When communication resources are available to support the call, the VCCU assigns communication resources to the call in step 516. Then, the VCCU and GW support establishment of a communication path between the non-passenger and passenger in step 518.

The VCCU monitors the call, in step 520, to determine when the call is completed. When the call is not completed, the procedure iterates as shown in FIG. 5. When the call is completed, the VCCU de-allocates the communication resources previously allocated to the call in step 522 and the procedure ends.

FIG. 6 illustrates a block diagram of VCCU 600 in accordance with a preferred embodiment of the present invention. VCCU 600 is used to provide communication capabilities for multiple communication units 620, where VCCU 600 and communication units 620 are co-located on a mobile vehicle. In a preferred embodiment, VCCU 600 includes processor 602, communication unit interface 604, RF interface 606, and memory device 608. In an alternate embodiment, VCCU 600 need not include memory device 608.

Communication unit interface 604 enables processor 602 to exchange data and messages with communication units 620 over links 622. Links 622 can be hard-wired or RF communication links. Data and messages exchanged between processor 602 and communication units 620 include, but are not limited to, user registration information, registration status information, billing information, and speech/data/fax information.

Processor 602 collects registration information users of communication units 620 and sends the registration information via RF interface 606 to the communication system. Processor 602 also performs re-registration when necessary.

During an attempt to establish an air-to-ground call, processor 602 receives an indication that the passenger wants to establish a communication path with a non-passenger and determines whether communication resources are available to support the call. If so, processor 602 assigns resources to the call and assists in call setup between passengers and non-passengers. If not, processor 602 can notify the passenger that the call cannot be completed at that time.

During an attempt to establish a ground-to-air call, processor 602 detects an incoming communication request which was originated by a non-passenger. Processor 602 correlates a destination identification number in the request with a list of previously registered identification numbers for passengers. Where a correlation exists, processor 602 assists in setting up the call. Processor 602 also performs other functions as described in FIGS. 2-5.

Memory device 608 is used to store information which processor 602 requires in order to perform its necessary functions. Memory device 608 can be a random access memory, read only memory, or any other type of storage medium and can be integral with or separate from processor 602. For example, memory device 608 could

store the list of previously registered identification numbers for passengers or the list of available MSISDNs.

As described previously, VCCU 600 sends registration information directly or indirectly to an ET (e.g., ET 102, FIG. 1). In conjunction with a GW (e.g., GW 104, FIG. 1), the ET attempts to register each user.

FIG. 7 illustrates a block diagram of ET apparatus 700 and GW apparatus 730 which support registration and call setup for co-located mobile communication unit groups in accordance with a preferred embodiment of the present invention. In a preferred embodiment, ET apparatus 700 includes processor 702 and RF interface 706.

ET apparatus 700 is in communication contact with GW apparatus 730 over link 720. Link 720 can be a hard-wired or RF link which could include one or more intermediate relay nodes (e.g., RF repeaters such as satellites). ET communicates either directly or indirectly with a VCCU (e.g., VCCU 600, FIG. 6) via RF interface 706.

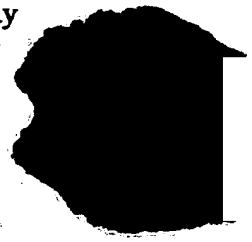
GW apparatus 730 includes Base Station Subsystem 732 (BSS), Mobile Switching Center 734 (MSC), and location registers 736. BSS 732 provides and manages transmission paths between communication units and MSC 734. MSC 734 is a point where user authentication is performed and where communications transit between the system and another network (e.g., a PSTN or other communication network). To determine whether a communication unit is allowed to use the system's services, registration information identifying the communication unit is sent from BSS 732 to MSC 734. After receiving the registration information, MSC 734 performs an authentication procedure to determine whether the communication unit is authorized to use the system. For a communication unit in roaming mode, MSC 734 also determines whether the system and the communication unit's home system have an agreement in place which ensures that the system will receive compensation for service it provides to the communication unit.

In a preferred embodiment, location registers 736 are coupled to MSC 734. Location registers 736 are typically one or more memory storage devices which contain the last known locations of communication units registered with the system. Where a communication unit is co-located with a mobile vehicle, the location information describes the last-known location of the mobile vehicle. The location information can be received as part of the registration information or in a message from the communication system.

Although BSS 732 and MSC 734 are names of devices familiar to those of skill in the art, the functions of the BSS 732 and MSC 734 for the purposes of this

description are explained herein. Limitations associated with the use of these names in other contexts are not intended to limit the scope of the present invention.

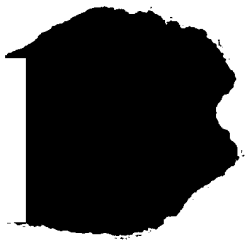
In summary, the method and apparatus of the present invention enables direct inward dialing to a passenger during a call attempt by a non-passenger by utilizing one-stage dialing rather than two-stage dialing. The method and apparatus of the present invention also provides communication services to a member of a mobile user-group who has not been pre-assigned a user code or PIN by the system. Further, a preferred embodiment of the method and apparatus of the present invention minimizes voice delay in communication systems which utilize satellite links by using low- or medium-earth satellite links rather than geosynchronous satellite links. Further, the method and apparatus of the present invention enables international callers to be able to contact passengers by eliminating the use of the "1-800" number stage of dialing.



## CLAIMS

What is claimed is:

1. A method for enabling a passenger in a mobile vehicle to communicate with a non-passenger, wherein the passenger is a registered subscriber of a home network, and the mobile vehicle comprises a control unit coupled to multiple communication units which can be operated by multiple passengers to communicate with multiple non-passengers, the method comprising the steps of:



a) receiving, from one of the multiple communication units operated by the passenger, registration information describing a subscriber identity which is unique to the passenger;

b) sending the registration information to the home network over a communication path between the mobile vehicle and the home network so that the home network will know how to route calls to the passenger; and

c) allowing the passenger to use communication resources of the control unit which enable communications to be maintained between the passenger and the non-passenger.

2. The method as claimed in claim 1, wherein step b) comprises the step of:

b1) sending the registration information over the communication path wherein a first link of the communication path is a radio-frequency link between the mobile vehicle and a satellite.

3. The method as claimed in claim 1, wherein step a) comprises the step of:

a1) receiving the registration information, wherein the registration information comprises a number provided by the passenger each time the passenger accesses the home network and the number enables a determination of an identity of the home network of the passenger.

4. The method as claimed in claim 3, wherein step a1) comprises the step of:

a1a) receiving the registration information, wherein the number is an alias designed to protect the subscriber identity.

5. The method as claimed in claim 1, further comprising the steps of:

d) calculating a first location of the mobile vehicle at a first time;

e) occasionally computing a distance from the first location which the mobile vehicle has traveled;

f) determining whether the distance exceeds a pre-defined re-registration distance; and

g) when the distance does exceed the pre-defined re-registration distance, repeating step b).

6. A method for enabling a passenger in a mobile vehicle to communicate with a non-passenger, wherein the passenger is a registered subscriber of a home network, and the mobile vehicle comprises a control unit coupled to multiple communication units which can be operated by multiple passengers to communicate with multiple non-passengers, the method comprising the steps of:

a) receiving, from the control unit, registration information describing a subscriber identity which is unique to the passenger;

b) determining, from the registration information, the home network of the passenger; and

c) sending the registration information and location information to the home network, wherein the location information describes a most-currently known location of the mobile vehicle, so that the home network can determine how to route information to the passenger.

7. The method as claimed in claim 6, wherein step a) comprises the step of:

a1) receiving, by a satellite, the registration information over a radio-frequency link between the satellite and the mobile vehicle.

8. The method as claimed in claim 6, further comprising the steps of:

d) calculating the most-currently known location of the mobile vehicle at a first time;

e) occasionally computing a distance from the most-currently known location which the mobile vehicle has traveled;

f) determining whether the distance exceeds a pre-defined re-registration distance; and

g) when the distance does exceed the pre-defined re-registration distance, repeating steps a-c.

9. A method for enabling a passenger in a mobile vehicle to communicate with a non-passenger, wherein the mobile vehicle comprises a control unit coupled to multiple communication units which can be operated by multiple passengers to communicate with multiple non-passengers, the method comprising the steps of:

a) receiving, from a communication unit operated by the passenger, an indication that the passenger has entered information ensuring that a fee can be collected for communications between the passenger and the non-passenger;

b) assigning a communication number with the passenger as a result of receiving the indication;

c) sending registration information to a communication system over a communication path between the mobile vehicle and the communication system, wherein the registration information informs the communication system how to route calls to the passenger; and

d) allowing the passenger to use communication resources of the control unit which enable a communication link to be maintained between the passenger and the non-passenger.

10. The method as claimed in claim 9, wherein step b) comprises the steps of:

b1) assigning the communication number to the passenger from a pool of available communication numbers accessible by the control unit; and

b2) sending the communication number to the communication unit so that the communication unit can display the communication number for the passenger.

11. The method as claimed in claim 9, wherein step b) comprises the steps of:

b1) receiving the communication number from the communication unit, wherein the communication number was pre-assigned to the passenger; and

b2) validating the communication number by determining whether the communication number is included in a pool of available communication numbers accessible by the control unit.

12. A method for setting up a call between a passenger of a mobile vehicle and a non-passenger over a communication system, wherein the mobile vehicle comprises a control unit coupled to multiple communication units which can be operated by multiple passengers to communicate with multiple non-passengers and the control unit has communication resources to support a finite number of communication paths between the multiple passengers and the multiple non-passengers, the method comprising the steps of:

a) receiving, from one of the multiple communication units operated by the passenger, an indication that the passenger wants to establish a communication path between the passenger and the non-passenger;

b) determining, as a result of the indication, whether the control unit has available resources of the communication resources to support the communication path;

c) when the control unit does have the available resources, assigning the available resources to the passenger; and

d) assisting in setting up the communication path between the passenger and the non-passenger.

13. The method as claimed in claim 12, further comprising the steps of:

e) when the control unit does not have the available resources, notifying the passenger that the communication path cannot currently be established;

f) monitoring the communication resources until the available resources exist; and

g) when the available resources exist, performing steps c-d.

14. The method as claimed in claim 12, further comprising the steps of:

e) determining, as a result of the indication, whether the passenger is a registered user who is allowed to use the communication resources of the control unit;

f) when the passenger is not the registered user, sending registration information describing a subscriber identity which is unique to the passenger to the communication system so that the communication system will know how to route calls to the passenger.

15. A method for setting up a communication path through a communication system between a first communication unit and a second communication unit, wherein the second communication unit is co-located with a mobile vehicle and can be operated by a passenger of the mobile vehicle, the first communication unit is not co-located with the mobile vehicle and can be operated by a non-passenger of the mobile vehicle, the mobile vehicle comprises a control unit coupled to multiple communication units, and the communication system comprises at least one gateway for storing registration information for users of the multiple communication units, the method comprising the steps of:

a) receiving identification information for the passenger during a call attempt by the first communication unit;

b) determining, from the identification information, a location of the passenger from registration information for the passenger which is accessible by the gateway, wherein the registration information comprises a last-known location of the mobile vehicle;

c) attempting to contact the second communication unit in a vicinity of the location; and

d) if attempting to contact the second communication unit is successful, supporting establishment of the communication path between the first communication unit and the second communication unit.

16. The method as claimed in claim 15, wherein step b) comprises the step of determining the location by determining a location area code which describes an last-known area where the mobile vehicle was located.

17. The method as claimed in claim 15, wherein step b) comprises the step of determining the location by extrapolating from a last-known point at which the mobile vehicle was located along a vector along which the mobile vehicle is traveling.

18. A method for a communication system to maintain knowledge of a location of multiple passengers who are co-located with a mobile vehicle in order to enable communication paths to be set up between multiple first communication units operated by the passengers and multiple second communication units operated by non-passengers, wherein the multiple first communication units are also co-located with the mobile vehicle, and the communication system comprises at least one gateway for storing registration information for the multiple passengers, the message comprising the steps of:

a) receiving the registration information for the multiple passengers, wherein the registration information includes location information describing a location of the mobile vehicle; and

b) individually registering each of the multiple passengers by associating the location information with each of the multiple passengers so that, when a communication attempt is made between a non-passenger and a passenger, the location information for the passenger can be accessed based on an identity of the passenger.

19. A method for setting up a communication path between a non-passenger and a passenger of a mobile vehicle over a communication system, wherein the mobile vehicle comprises a control unit coupled to multiple communication units which can be operated by multiple passengers to communicate with multiple non-passengers and the control unit comprises communication resources to support a finite number of communication paths between the multiple passengers and the multiple non-passengers, the method comprising the steps of:

a) detecting, by the control unit, an incoming call request, wherein the incoming call request results from an attempt by the non-passenger to reach the passenger and comprises a destination identification number which could identify the passenger;

b) determining whether the destination identification number correlates with any of multiple registered identification numbers included in a list, wherein each of the multiple passengers who have registered with the communication system were previously allocated a registered identification number in the list; and

c) when the destination identification number does correlate with one of the multiple registered identification numbers, assisting in setting up the communication path between the non-passenger and the passenger who is associated with the one of the multiple registered identification numbers.

20. The method as claimed in claim 19, wherein the multiple registered identification numbers included in the list are provided by the passenger each time the passenger accesses a home network of the passenger and each of the multiple registered identification numbers enables a determination of an identity of the home network of the passenger.

21. The method as claimed in claim 20, wherein the multiple registered identification numbers are aliases designed to protect an identity of the passenger.

22. The method as claimed in claim 19, wherein each of the multiple registered identification numbers included in the list is a unique number which is pre-assigned to the passenger and which the non-passenger sends as the destination identification number.

23. The method as claimed in claim 19, wherein each of the multiple registered identification numbers included in the list is a number which points to a record in a home network for the passenger, wherein the record includes a current location of the passenger.

24. A method for setting up a call between a non-passenger and a passenger of a mobile vehicle over a communication system which comprises at least one satellite, wherein the mobile vehicle comprises a control unit coupled to multiple communication units which can be operated by multiple passengers to communicate with multiple non-passengers and the control unit has communication resources to support a finite number of communication paths between the multiple passengers and the multiple non-passengers, wherein a first link of each of the communication paths is a link between the mobile vehicle and a satellite of the at least one satellite, the method comprising the steps of:

a) sending, by a communication unit operated by the non-passenger, a destination identification number which identifies the passenger;

b) determining, by the communication system, a last-known location of the passenger identified by the destination identification number, wherein, when the passenger is co-located with the mobile vehicle, the last-known location also corresponds to a last-known location of the control unit;

c) conveying, by the communication system, an incoming call request to the control unit, wherein the incoming call request includes the desitnation identification number;

d) determining, by the control unit, whether the destination identification number correlates with any of multiple registered identification numbers included in a list, wherein each of the multiple passengers who have registered with the communication system were previously allocated a registered identification number in the list; and

e) when the destination identification number does correlate with one of the multiple registered identification numbers, assisting in setting up the communication path between the non-passenger and the passenger who is associated with the one of the multiple registered identification numbers.

25. A method for setting up a call between a passenger of a mobile vehicle and a non-passenger over a communication system which comprises at least one satellite, wherein the mobile vehicle comprises a control unit coupled to multiple communication units which can be operated by multiple passengers to communicate with multiple non-passengers and the control unit has communication resources to support a finite number of communication paths between the multiple passengers and the multiple non-passengers, wherein a first link of each of the communication paths is a link between the mobile vehicle and a satellite of the at least one satellite, the method comprising the steps of:

a) receiving, by the control unit, from one of the multiple communication units operated by the passenger, an indication that the passenger wants to establish a communication path between the passenger and the non-passenger;

b) determining, as a result of the indication, whether the control unit has available resources of the communication resources to support the communication path;

c) when the control unit does have the available resources, assigning the available resources for to the passenger; and

d) assisting in setting up the communication path between the passenger and the non-passenger through the satellite.

26. A control unit apparatus located on a mobile vehicle for supporting set up of a communication path between a non-passenger and a passenger of the mobile vehicle over a communication system, wherein the mobile vehicle comprises a control unit coupled to multiple communication units which can be operated by multiple passengers to communicate with multiple non-passengers and the control unit comprises communication resources to support a finite number of communication paths between the multiple passengers and the multiple non-passengers, the control unit apparatus comprising:

a processor for communicating with the multiple communication units, performing a registration procedure between the passenger and the communication system, for determining whether communication resources are available to support the communication link between the mobile vehicle and the communication system, and for assisting in setting up the communication path between the passenger and the non-passenger;

a memory device coupled to the processor for storing registration information obtained during the registration procedure; and

a radio frequency (RF) interface coupled to the processor for sending the registration information to the communication system and for supporting the communication path between the mobile vehicle and the communication system.

27. The control unit apparatus as claimed in claim 26, wherein the communication system comprises at least one satellite and the RF interface is for supporting the communication path between the mobile vehicle and the at least one satellite of the communication system.

28. The control unit apparatus as claimed in claim 26, wherein the processor is further for performing a re-registration process when a distance between a previous registration location and a current location of the mobile vehicle exceeds a pre-defined re-registration distance.

29. The control unit apparatus as claimed in claim 26, wherein the processor is further for supporting setup of a communication attempt originated by a passenger and destined for a non-passenger by

receiving, from one of the multiple communication units operated by the passenger, an indication that the passenger wants to establish a communication path between the passenger and the non-passenger,

determining, as a result of the indication, whether the control unit has available resources of the communication resources to support the communication path,

when the control unit does have the available resources, assigning the available resources for to the passenger, and

assisting in setting up the communication path between the passenger and the non-passenger.

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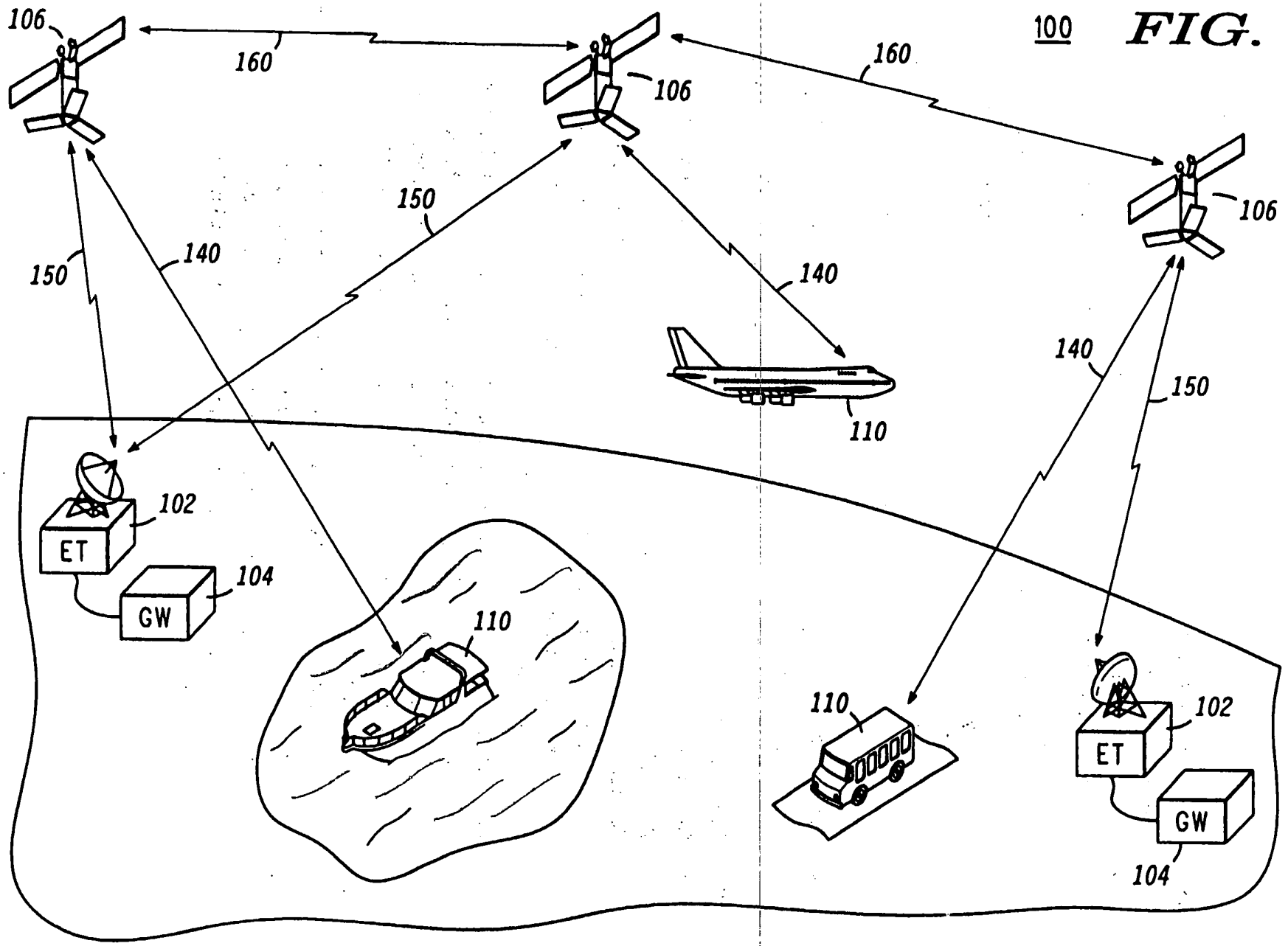
30. The control unit apparatus as claimed in claim 26, wherein the processor is further for supporting setup of a communication attempt originated by a non-passenger and destined for a passenger by

detecting an incoming communication attempt message from the non-passenger, wherein the incoming communication attempt message comprises a destination identification number which identifies a particular destination,

determining whether the destination identification number correlates with any of multiple registered identification numbers included in a list, wherein each of the multiple passengers who have registered with the communication system were previously allocated a registered identification number in the list, and

when the destination identification number does correlate with one of the multiple registered identification numbers, assisting in setting up the communication path between the non-passenger and the passenger who is associated with the one of the multiple registered identification numbers.


100
106
160
106
160
106
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140
150
110
102
ET
104
GW
110
110
102
ET
GW
104

FIG. 1

1/6

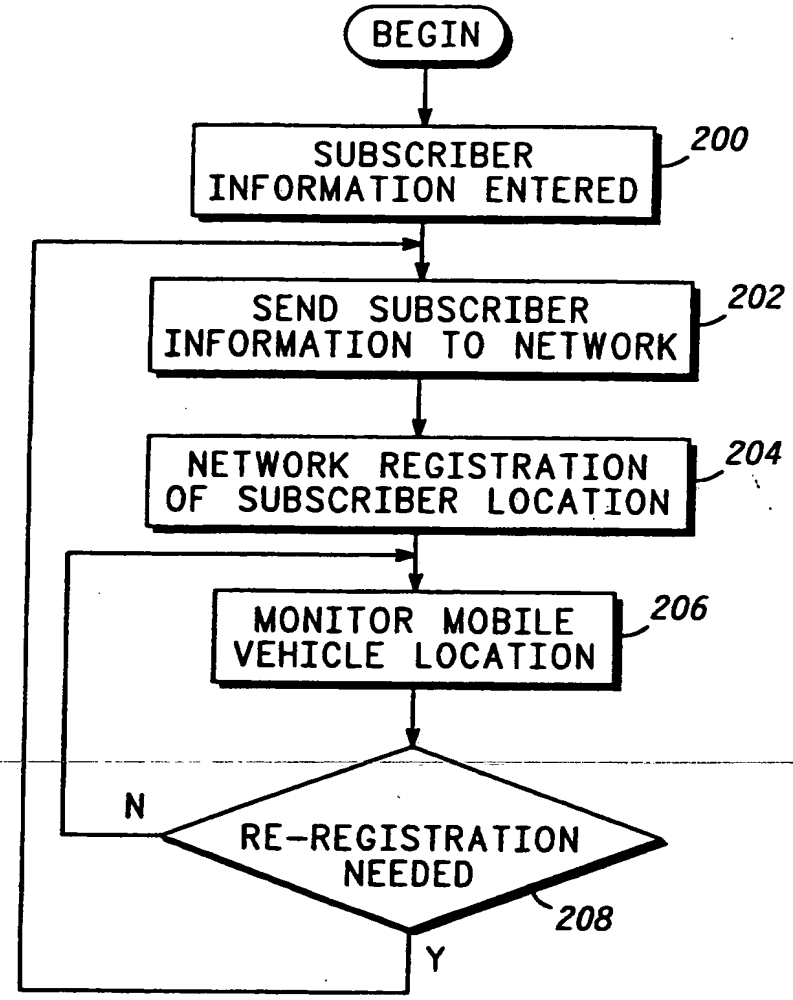
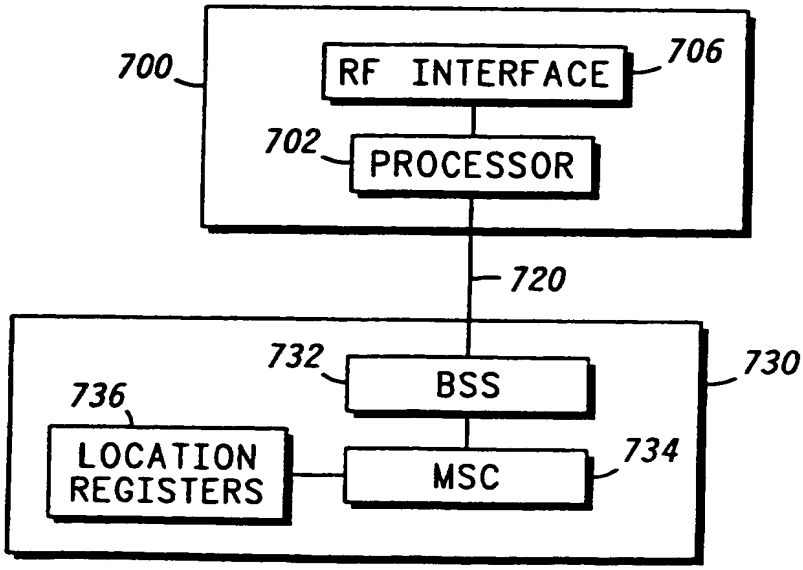

BEGIN
SUBSCRIBER INFORMATION ENTERED
200
SEND SUBSCRIBER INFORMATION TO NETWORK
202
NETWORK REGISTRATION OF SUBSCRIBER LOCATION
204
MONITOR MOBILE VEHICLE LOCATION
206
RE-REGISTRATION NEEDED
208
N
Y

FIG. 2

FIG. 7


700
RF INTERFACE
706
702
PROCESSOR
720
732
BSS
730
736
LOCATION REGISTERS
734
MSC

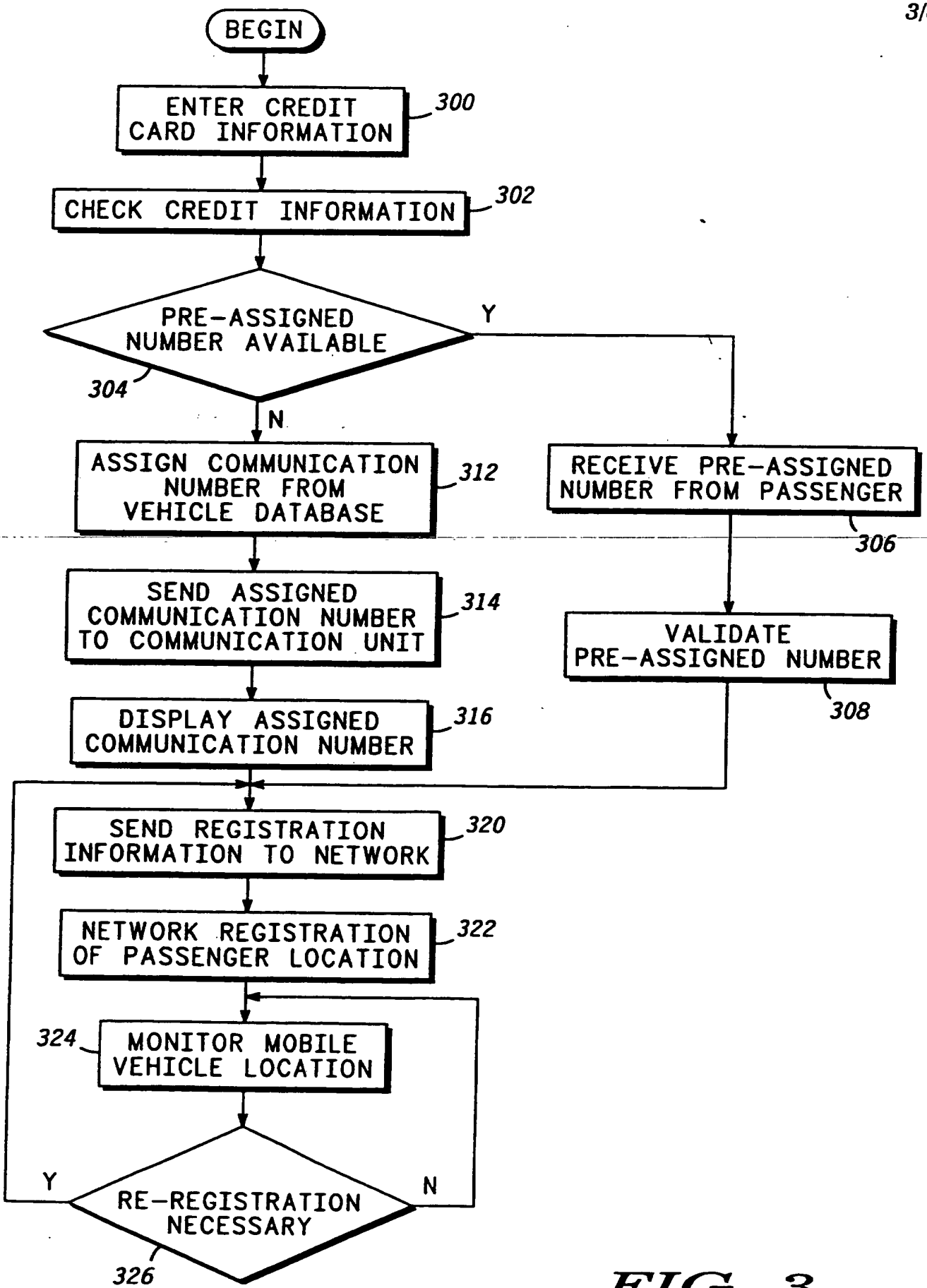

BEGIN
ENTER CREDIT CARD INFORMATION
300
CHECK CREDIT INFORMATION
302
PRE-ASSIGNED NUMBER AVAILABLE
304
Y
N
ASSIGN COMMUNICATION NUMBER FROM VEHICLE DATABASE
312
RECEIVE PRE-ASSIGNED NUMBER FROM PASSENGER
306
SEND ASSIGNED COMMUNICATION NUMBER TO COMMUNICATION UNIT
314
VALIDATE PRE-ASSIGNED NUMBER
308
DISPLAY ASSIGNED COMMUNICATION NUMBER
316
SEND REGISTRATION INFORMATION TO NETWORK
320
NETWORK REGISTRATION OF PASSENGER LOCATION
322
MONITOR MOBILE VEHICLE LOCATION
324
RE-REGISTRATION NECESSARY
326
Y
N

FIG. 3

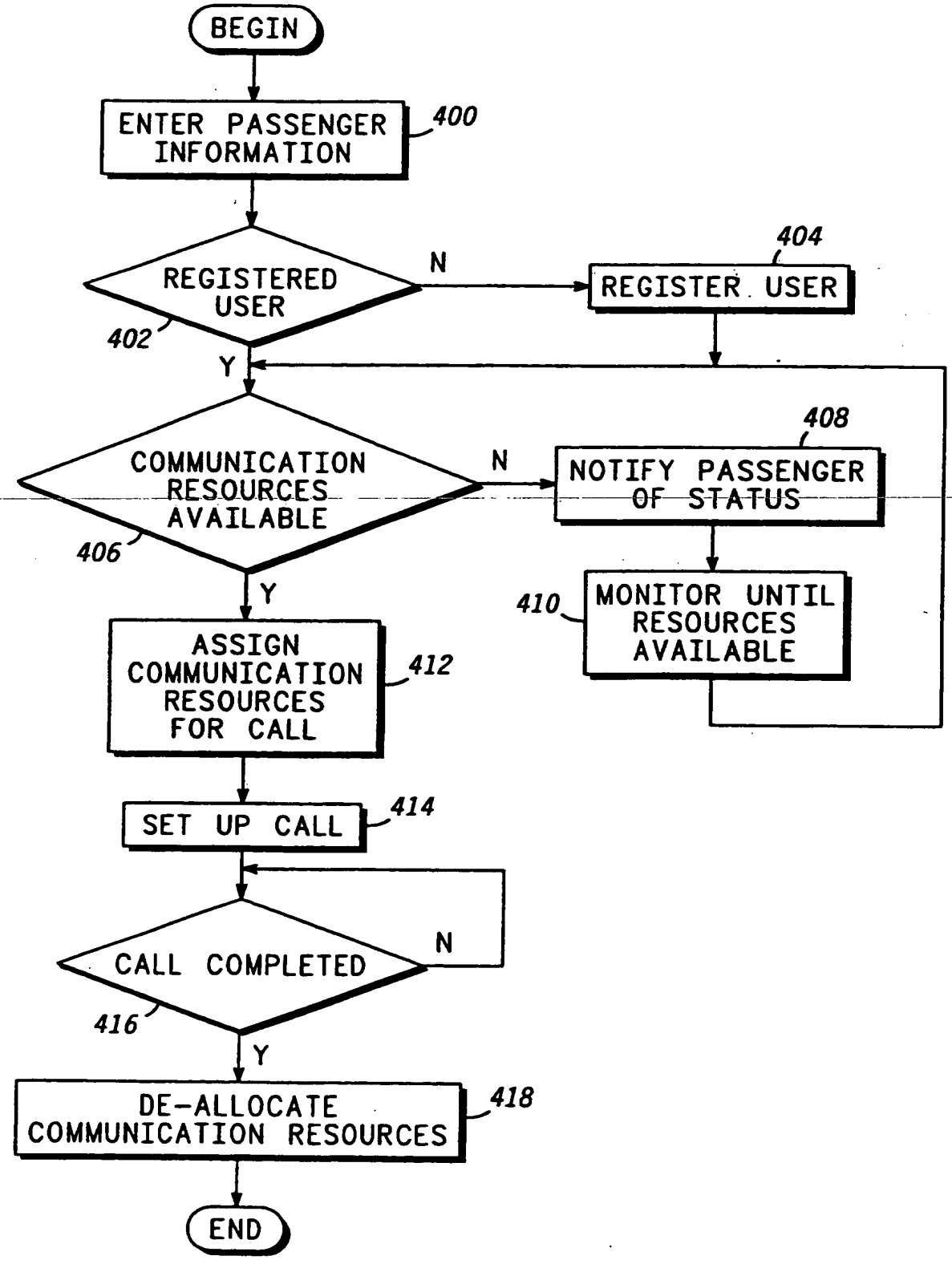

BEGIN
ENTER PASSENGER INFORMATION
400
REGISTERED USER
402
N
REGISTER USER
404
Y
COMMUNICATION RESOURCES AVAILABLE
406
N
NOTIFY PASSENGER OF STATUS
408
MONITOR UNTIL RESOURCES AVAILABLE
410
Y
ASSIGN COMMUNICATION RESOURCES FOR CALL
412
SET UP CALL
414
CALL COMPLETED
416
N
Y
DE-ALLOCATE COMMUNICATION RESOURCES
418
END

FIG. 4

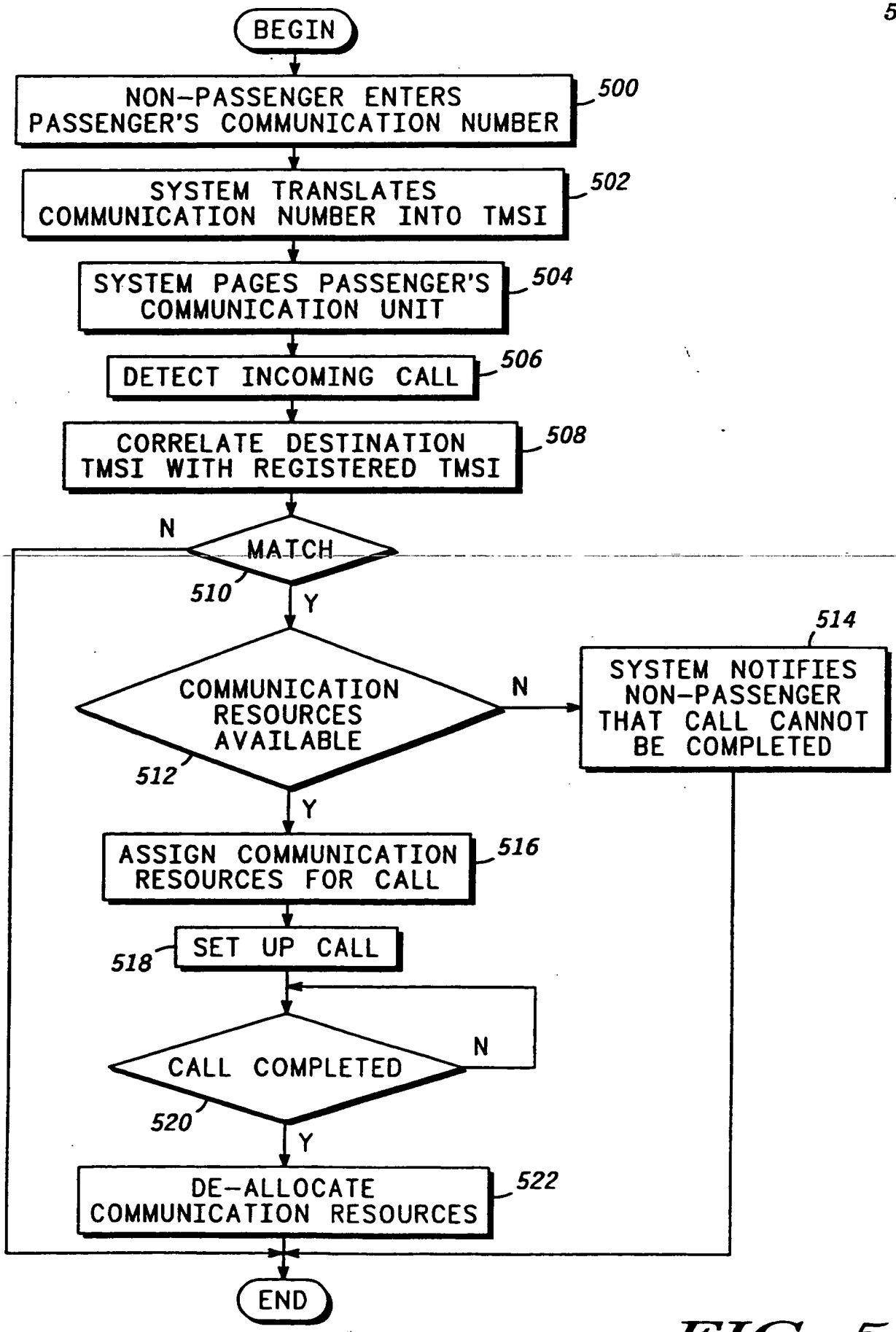

BEGIN
NON-PASSENGER ENTERS PASSENGER'S COMMUNICATION NUMBER
500
SYSTEM TRANSLATES COMMUNICATION NUMBER INTO TMSI
502
SYSTEM PAGES PASSENGER'S COMMUNICATION UNIT
504
DETECT INCOMING CALL
506
CORRELATE DESTINATION TMSI WITH REGISTERED TMSI
508
MATCH
510
N
Y
COMMUNICATION RESOURCES AVAILABLE
512
N
Y
514
SYSTEM NOTIFIES NON-PASSENGER THAT CALL CANNOT BE COMPLETED
ASSIGN COMMUNICATION RESOURCES FOR CALL
516
SET UP CALL
518
CALL COMPLETED
520
N
Y
DE-ALLOCATE COMMUNICATION RESOURCES
522
END

FIG. 5

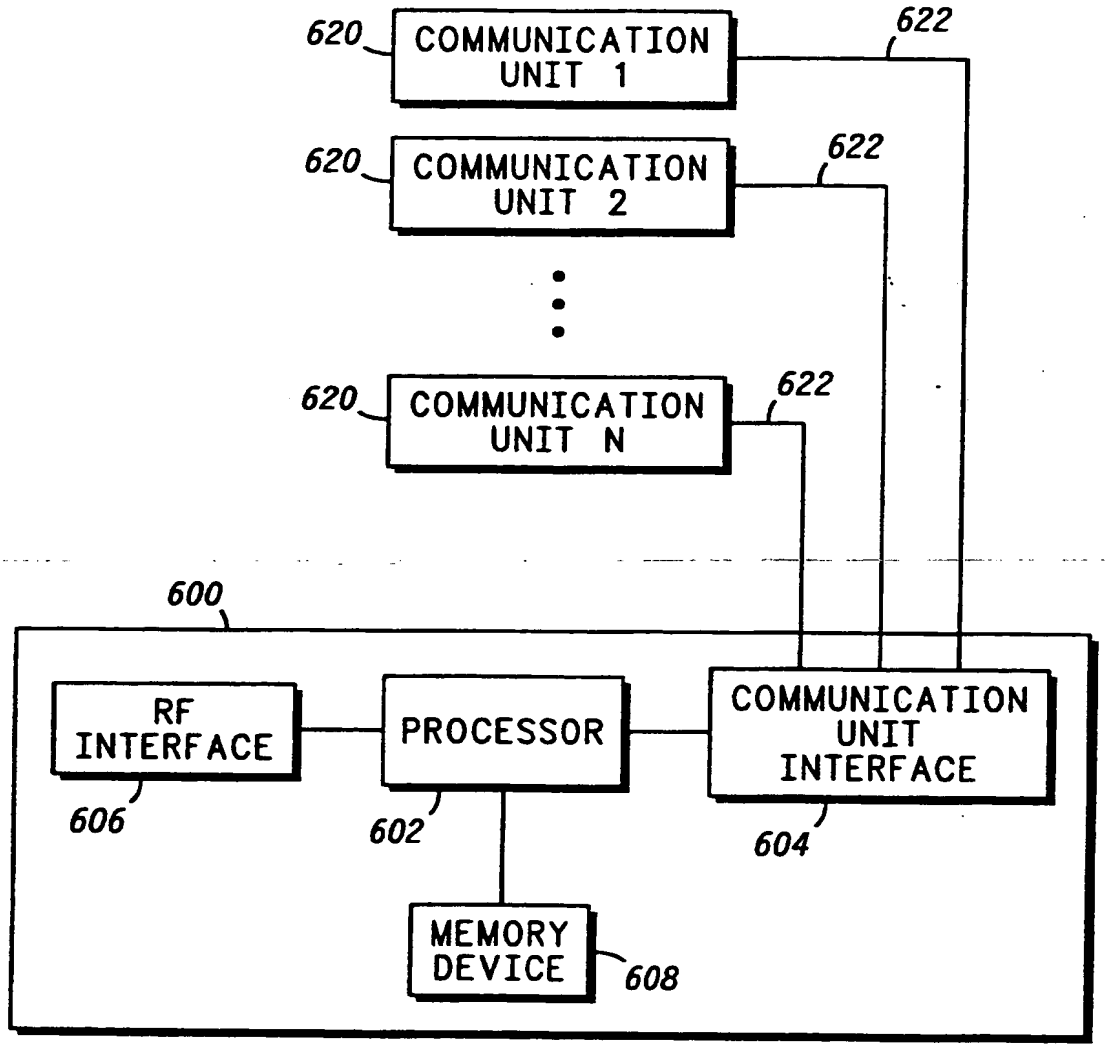

620
COMMUNICATION UNIT 1
622
620
COMMUNICATION UNIT 2
622
620
COMMUNICATION UNIT N
622
600
RF INTERFACE
606
PROCESSOR
602
COMMUNICATION UNIT INTERFACE
604
MEMORY DEVICE
608

FIG. 6

The Patent Office

| | | | |
|---|---|---|---|
| **Application No:** | GB 9626272.0 | **Examiner:** | Mr Jared Stokes |
| **Claims searched:** | 1-11,26-30 | **Date of search:** | 5 March 1997 |

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H4L (LDSC, LDSL, LDSM, LDRR, LDRSX)

Int Cl (Ed.6): H04B (7/185, 7/26)
H04M (1/00)
H04Q (7/38)

Other: On-Line - WPI

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | Relevant to claims |
|---|---|---|
| X | US 4 399 330 (Siemens) See whole document | 1-4 |

| | | | |
|---|---|---|---|
| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
| & | Member of the same patent family | E | Patent document published on or after, but with priority date earlier than, the filing date of this application. |